[JP,11-172359,A]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.screw shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] A screw made from a high intensity aluminium alloy characterized by containing Mg:0.5 - 1.5wt% Si:0.5 - 1.5wt% Cu:0.5 - 1.5wt% Mn:0.2 - 0.5wt% Ti:0.005 - 0.1wt% B:0.001 - 0.05wt% Zr:0.05 - 0.25wt% and remainder consisting of aluminum and an unescapable impurity.

[Claim 2] A screw made from a high intensity aluminium alloy characterized by consisting of Mg: 0.5 - 1.5wt% Si:0.5 - 1.5wt% Cu:0.5 - 1.5wt% Mn: 0.2 - 0.5wt% Ti:0.005 - 0.1wt%, B:0.001 - 0.05wt % Zr:0.05 - 0.25wt%, and at least one sort in Sc, rare earth elements, when each independently including, Sc:0.05-1wt%, rare earth elements: 0.05-1wt%, V:0.05-0.5wt%,and adding two or more kinds, total of each addition considers as 0.05 - 0.7wt%, and remainder consisnting aluminum and an unescapable impurity.

[Claim 3] A method of producing screw made from a high intensity aluminium alloy containing Mg: 0.5 - 1.5wt% Si:0.5 - 1.5wt% Cu:0.5 - 1.5wt% Mn: 0.2 - 0.5wt% Ti:0.005 - 0.1wt%, B:0.001 - 0.05wt %, Zr:0.05 - 0.25wt%, and reminder consisting of aluminum and an unescapable impurity, the alloy is dissolved, casted, and the ingot obtained is homogenized. Subsequently It is processed into the strand for screw by either the extrusion method, the drawing method or the rolling-out method, putting in annealing suitably. After making working ratio after the last annealing of this strand for screw threads into 40% or more and annealing this strand for screw threads at predetermined temperature subsequently, Fabricate said strand to screw, quench this screw-thread Plastic solid after solution treatment, and, subsequently artificial-aging hardening processing is performed. They are 200 micrometers or less and tensile strength 350Ns/mm about the crystal grain die length of a longitudinal

direction 2 Above, It is proof stress 300Ns/mm 2 They are 6% or more and torsional strength about elongation above JIS-B -1057-1989 The manufacture approach of screw made from a high intensity aluminium alloy characterized by making it a value higher 10% or more than the screw-thread strength of AL3 (A6061-T6).

[Claim 4] A method of producing screw made from a high intensity aluminium alloy containing Mg: 0.5 - 1.5wt% Si:0.5 - 1.5wt% Cu:0.5 - 1.5wt% Mn: 0.2 - 0.5wt% Ti:0.005 - 0.1wt%, B:0.001 - 0.05wt % Zr:0.05 - 0.25wt%, and at least one sort in Sc, rare earth elements, when each independently including, Sc:0.05-1wt%, rare earth elements: 0.05-1wt%, V:0.05-0.5wt%,and adding two or more kinds, total of each addition considers as 0.05 - 0.7wt%, and remainder consisnting aluminum and an unescapable impurity, the alloy is dissolved, casted, and the ingot obtained is homogenized. Subsequently It is processed into the strand for screw by either the extrusion method, the drawing method or the rolling-out method, putting in annealing suitably. After making working ratio after the last annealing of this strand for screw threads into 40% or more and annealing this strand for screw threads at predetermined temperature subsequently, Fabricate said strand to screw, quench this screw-thread Plastic solid after solution treatment, and, subsequently artificial-aging hardening processing is performed. They are 200 micrometers or less and tensile strength 350Ns/mm about the crystal grain die length of a longitudinal direction 2 Above, It is proof stress 300Ns/mm 2 They are 6% or more and torsional strength about elongation above JIS-B -1057-1989 The manufacture approach of screw made from a high intensity aluminium alloy characterized by making it a value higher 10% or more than the screw-thread strength of AL3 (A6061-T6).

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to screw made from a 6000 system aluminium alloy and its manufacture approach of high intensity.

[0002]

[Description of the Prior Art] With corrosive environment, although it is satisfactory in reinforcement, in order that electric corrosion may occur, steel screw (it represents with following screw containing a bolt) used for the assembly of the structure made from an aluminium alloy galvanizes Zn

or nickel, and is used. However, plating cannot separate, or electric corrosion cannot be prevented when corrosive environment is especially bad. About steel screw, it is JIS-B -1051-1991. Specification is carried out by "the mechanical property of a steel bolt and a machine screw." Since it is congenial and hard to carry out electric corrosion of the screw made from stainless steel to an aluminium alloy, it is used for the structure made from an aluminium alloy of many including the sash for apertures of A6063 alloy. About screw made from stainless steel, it is JIS-B -1054-1985. Specification is carried out by "the mechanical property of the anticorrosion threaded fastener made from stainless steel."

[0003] By the way, recycle of an ingredient is strongly cried for from viewpoints, such as effective use of an earth resource, energy saving, and environmental defecation, in recent years. Although immense electrical energy is required for aluminum's refining the bauxite of a raw material and using it as a metal, the screw** recycle effectiveness of aluminum is so large in energy to remelting of an aluminum scrap because of a low-melt point point. However, since steel or screw made from stainless steel will dissolve the scrap of the structure made from an aluminium alloy if it is remelted as it is, the purity of the aluminium alloy obtained falls. Removing and remelting screw requires time and effort, and the recycle effectiveness is halved.

[0004] The problem of the purity fall by said remelting can be solved by using screw made from an aluminium alloy, and screw made from an aluminium alloy is marketed actually. It is desirable to use screw of the same 6000 system alloy for example, for the sash for the apertures made from A6063 alloy from the point of recycle. About screw made from an aluminium alloy, it is JIS-B -1057-1989. Specification is carried out by "the mechanical property of the threaded fastener made from a nonferrous metal."

[0005] On the other hand, in an automobile industry, efforts are continued to energy saving or environmental defecation, and the most leading cure is settling in aluminum-izing a car body and making it light. The space frame type which puts the body on the profile used as a bone is examined from the conventional monocoque type which the structure of an aluminum car body made use a member on the strength also [plate / press-working-of-sheet-metal]. The probability that the JIS-A6000 system alloy which is excellent in high intensity also at extrusion nature is adopted as said profile is high. Instead of the conventional resistance spot welding, the mechanical junction using energy-saving-[dependability / it is reliable and] screw is expected to be adopted as junction of a profile and

the body on a grand scale. Recycle nature is required also of the automobile of an aluminum car body, naturally screw made from an aluminum containing alloy is used there, and the same 6000 system alloy as a profile is desirable into the alloy.

[0006] By the way, JIS-B -1057-1989 Six kinds, AL1 (A5052), AL2 (A5056), AL3 (A6061), AL4 (A2024), AL5 (7N01), and AL6 (A7075), are standardized as screw made from an aluminium alloy by "the mechanical property of the threaded fastener made from a nonferrous metal." The specification of a screw thread (a bolt is included) is shown in Table 1.

[0007]

[Table 1]

(Note) Torsional strength of **M4, unit:N-M. Torsional strength is specified for every diameter of screw. It is carried out.

[0008] Next, the conventional production process of said screw thread is shown.

(1) AL1 (A5052) .... Casting -> homogenization -> extrusion -> drawing -> strand ->screw ->**H16 material -- -> cutting -> -- completion ->**O material -> Header processing and thread rolling processing (H16) -> completion (2) AL2 (A5056) .... Casting -> homogenization -> extrusion -> drawing -> strand ->screw ->**H16 material -- -> cutting -> -- completion ->**O material -> Header processing and thread rolling processing (H16) -> completion (3) AL3 (A6061) .... Casting -> homogenization -> extrusion -> drawing -> strand ->screw ->**T6 processing -> cutting -> Completion ->**O material -> Header processing and thread rolling processing ->T6 processing -> completion (4) AL4 (A2024) .... Casting -> homogenization -> extrusion -> drawing -> strand ->screw ->**T-four processing -> cutting -> completion -> -- **O material -- -> header processing and thread rolling processing ->T-four processing -> completion screw (5) AL5 (A7N01) .... casting -> homogenization -> extrusion -> drawing -> strand -> -- ->**T6 processing -> cutting -> Completion ->**O material -> Header processing and thread rolling processing ->T6 processing -> completion (6) AL6 (A7075) .... Casting -> homogenization -> extrusion -> drawing -> strand ->screw ->**T6 processing -> cutting -> completion ->**O material -> Header processing and thread rolling processing ->T6 processing -> completion [0009]

[Problem(s) to be Solved by the Invention] The trouble in the case of using for the sash for apertures or an automobile the conventional screw produced at said process is as follows.

(1) Since AL1 (A5052) is not a 6000 system alloy, it is inferior to recycle

nature. Reinforcement is low (300N/mm2 following) and cutting material has high processing cost. Header processing and thread rolling work timber have low reinforcement (300N/mm2 following).
(2) Since AL(s)2 (5056) are not 6000 systems, they are inferior to recycle nature. Cutting material has high cost. Since header processing and thread rolling work timber have bad workability, it is easy to be divided during processing.
(3) About AL3 (A6061), cutting material has high processing cost. Workability is bad and header processing and thread rolling work timber tend to break during processing.
(4) Since AL(s)4 (A2024) are not 6000 systems, they are inferior to recycle nature. Moreover, it is easy to corrode. Cutting material has high processing cost. Workability is bad and header processing and thread rolling work timber tend to break during processing.
(5) Since AL(s)5 (A7N01) are not 6000 systems, they are inferior to recycle nature. Moreover, it is easy to corrode. Cutting material has high processing cost. Workability is bad and header processing and thread rolling work timber tend to break during processing.
(6) Since AL(s)6 (A7075) are not 6000 systems, they are inferior to recycle nature. Moreover, it is easy to corrode. Cutting material has high processing cost. Workability is bad and header processing and thread rolling work timber tend to break during processing.
[0010] When it asks for a 6000 system alloy into said screw-thread specification, there is AL3. 2, 2 and 7% of elongation with a tensile strength of 320Ns [/mm], and torsional strength (M4) 1.4 N-m of AL3 (A6061-T6) are values of standard. [with a proof stress of 250Ns //mm] In screw used for the prefabricated frame structure of an automobile, it is 2 the tensile strength of 350Ns/mm. It is 2 300Ns [/mm] proof stress above. Above, 6% or more of elongation is required, and since the inclination for torsional strength to shift to a tapping screw type from the conventional bolt nut type is seen, a value with the value of standard of AL3 high 10% or more is desired. Furthermore, not to rust and to be low cost are also desired. This invention is 2 the tensile strength of 350Ns/mm. It is 2 300Ns [/mm] proof stress above. Above, AL3 value of standard of 6% or more of elongation and torsional strength is high 10% or more, they have the mechanical property which bears the prefabricated frame structure of an automobile enough, moreover cannot rust easily, and aim at offer of screw made from a high intensity aluminium alloy of low cost.
[0011]
[Means for Solving the Problem] Invention according to claim 1 is screw

made from a high intensity aluminium alloy characterized by containing Zr:0.05 - 0.25wt% and consisting of remainder aluminum and an unescapable impurity B:0.001 - 0.05wt% Ti:0.005 - 0.1wt% Mn:0.2 - 0.5wt% Cu:0.5 - 1.5wt% Si:0.5 - 1.5wt% Mg:0.5 - 1.5wt%.

[0012] Invention according to claim 2 Mg:0.5 - 1.5wt% and Si:0.5 - 1.5wt%, Cu: 0.5 - 1.5wt% and Mn:0.2 - 0.5wt% and Ti:0.005 - 0.1wt%, When Zr:0.05 - 0.25wt% is contained and it adds each independently B:0.001 - 0.05wt% including at least one sort in Sc, rare earth elements, and V Sc: 0.05 - 1wt%, rare earth elements : when considering as V:0.05 - 0.5wt% and adding two or more kinds to coincidence 0.05 - 1wt% Total of each addition is screw made from a high intensity aluminium alloy which considers as 0.05 - 0.7wt% and is characterized by consisting of remainder aluminum and an unescapable impurity.

[0013] Invention according to claim 3 Mg:0.5 - 1.5wt% and Si:0.5 - 1.5wt%, Cu: 0.5 - 1.5wt% and Mn:0.2 - 0.5wt% and Ti:0.005 - 0.1wt%, B:0.001 - 0.05wt%, Zr:0.05 - 0.25wt% is contained, the aluminium alloy which consists of remainder aluminum and an unescapable impurity is dissolved, it casts, and the ingot obtained is homogenized. Subsequently It is processed into the strand for screw by either the extrusion method, the drawing method or the rolling-out method, putting in annealing suitably. After making working ratio after the last annealing of this strand for screw threads into 40% or more and annealing this strand for screw threads at predetermined temperature subsequently, Fabricate said strand to screw, quench this screw-thread Plastic solid after solution treatment, and, subsequently artificial-aging hardening processing is performed. They are 200 micrometers or less and tensile strength 350Ns/mm about the crystal grain die length of a longitudinal direction 2 Above, It is proof stress 300Ns/mm 2 They are 6% or more and torsional strength about elongation above JIS-B -1057-1989 It is the manufacture approach of screw made from a high intensity aluminium alloy characterized by making it a value higher 10% or more than the screw-thread strength of AL3 (A6061-T6).

[0014] Invention according to claim 4 Mg:0.5 - 1.5wt% and Si:0.5 - 1.5wt%, Cu: 0.5 - 1.5wt% and Mn:0.2 - 0.5wt% and Ti:0.005 - 0.1wt%, When Zr:0.05 - 0.25wt% is contained and it adds each independently B:0.001 - 0.05wt% including at least one sort in Sc, rare earth elements, and V Sc: 0.05 - 1wt%, rare earth elements : when considering as V:0.05 - 0.5wt% and adding two or more kinds to coincidence 0.05 - 1wt% Total of each addition considers as 0.05 - 0.7wt%, and the aluminium alloy which consists of remainder aluminum and an unescapable impurity is dissolved, it casts, and the ingot obtained is homogenized. Subsequently It is processed into the strand for

screw by either the extrusion method, the drawing method or the rolling-out method, putting in annealing suitably. After making working ratio after the last annealing of this strand for screw threads into 40% or more and annealing this strand for screw threads at predetermined temperature subsequently, Fabricate said strand to screw, quench this screw-thread Plastic solid after solution treatment, and, subsequently artificial-aging hardening processing is performed. They are 200 micrometers or less and tensile strength 350Ns/mm about the crystal grain die length of a longitudinal direction 2 Above, It is proof stress 300Ns/mm 2 They are 6% or more and torsional strength about elongation above JIS-B -1057-1989 It is the manufacture approach of screw made from a high intensity aluminium alloy characterized by making it a value higher 10% or more than the screw-thread strength of AL3 (A6061-T6).

[0015]

[Embodiment of the Invention] In this invention, Mg and Si are the main configuration elements of this invention screw, and contribute to the improvement in on the strength. When Mg and Si live together, by hardening and artificial-aging hardening processing, Mg2 Si deposits and reinforcement improves. In this invention, the reason for specifying Mg 0.5 - 1.5wt% and specifying Si to 0.5 - 1.5wt%, respectively is for tractive characteristics, torsional strength, header workability, and forming-of-rolling nature to fall, even if any of the reinforcement do not improve enough even less than [0.5wt%] and any exceed 1.5wt(s)%.

[0016] Cu contributes to the improvement in on the strength with Mg and Si. At less than 0.5%, the reason for specifying the content to 0.5 - 1.5wt% is for tractive characteristics, torsional strength, header workability, forming-of-rolling nature, and corrosion resistance to fall, when the effectiveness is not fully acquired but exceeds 1.5wt%.

[0017] A part of Mn dissolves to a matrix, and contributes to the improvement in on the strength. Moreover, it combines with the aluminum-Fe system compound contained as an impurity, the rod-like compound of an aluminum-Fe-Mn system is formed, and it contributes to improvement in header workability and forming-of-rolling nature. Furthermore, Mn promotes the deposit of Mg2Si. If the effectiveness is not fully acquired less than [0.2wt%] but Mn exceeds 1.5wt%, huge inclusion will generate and tractive characteristics, torsional strength, header workability, and forming-of-rolling nature will fall. therefore, Mn -- 0.2 - 0.5wt% -- it is made to contain

[0018] Ti or/and B improve casting crack nature, and raise header workability and forming-of-rolling nature. If less than [0.005wt%] is not

obtained for Ti, and the effectiveness is not fully acquired for B less than [0.001wt%], Ti exceeds 0.1wt(s)% or B exceeds 0.05wt(s)%, big and rough inclusion will generate and tractive characteristics, torsional strength, header workability, and forming-of-rolling nature will fall. therefore, Ti -- 0.005 - 0.1wt% and B -- 0.001 - 0.05wt% -- it is made to contain

[0019] Zr prevents big and rough-ization of the crystal grain at the time of heat treatment, and raises header workability and forming-of-rolling nature especially. If, as for the content of Zr, 0.25wt% is exceeded by fully not acquiring the effectiveness less than [0.05wt%], big and rough inclusion will generate and tractive characteristics, torsional strength, header workability, and forming-of-rolling nature will fall.

[0020] Each of Sc, rare earth elements, and V promotes detailed-ization of the crystalline structure, and improves tensile strength, torsional strength, header workability, and forming-of-rolling nature. Less than [0.05wt%], when using Sc, rare earth elements, and V independently, if the effectiveness is not fully acquired but the content of Sc and rare earth elements exceeds 1wt%, and if the content of V exceeds 0.5wt(s)%, big and rough inclusion will generate and tractive characteristics, torsional strength, header workability, and forming-of-rolling nature will fall, respectively. When making two or more [of Sc, rare earth elements, and the V] contain, if the effectiveness is not fully acquired for the sum of each content (wt%) less than [0.05wt%] but the sum of Sc, rare earth elements, and the content of V exceeds 0.7wt(s)%, big and rough inclusion will generate and tractive characteristics, torsional strength, header workability, and forming-of-rolling nature will fall.

[0021] As rare earth elements, among La, Ce, Pr, Nd, Sm, etc., to be able to use two or more sorts and what is necessary is just one sort or the range any one sort of contents or whose content of two or more sorts of sum totals is 0.05 - 1wt% among these. As an alloy containing two or more sorts in said many elements, there is a misch metal (it usually consists of the rare earth elements (Pr, Nd, Sm, etc.) and the unescapable impurity of the remainder and others La20 - 40wt% Ce45 - 50wt%) which uses Ce and La as a principal component. Although each each aforementioned rare earth elements and an aforementioned misch metal show equivalent effectiveness, its misch metal is more advantageous in price at a low price than a rare-earth-elements simple substance.

[0022] In this invention, after dissolving said alloy with a conventional method, casting and homogenizing to the ingot obtained, it is processed into the strand for screw by the approach of extrusion, drawing or rolling either, putting in annealing. In this invention, working ratio is subsequent

annealing at less than 40%, and the reason for making working ratio after the last annealing of the strand for screw 40% or more is for crystal grain to make it big and rough, and for header workability and forming-of-rolling nature to fall, and to become easy to generate defects, such as a crack, during screw processing, although Zr is added. If workability after the last annealing of the strand for screw threads is made 40% or more, crystal grain does not make subsequent annealing big and rough by the synergistic effect with Zr, either, but while crystal grain has been detailed, defects, such as a crack, will not occur during header processing and forming of rolling of screw, but processing will be performed easily.

[0023] After annealing the strand for screw threads so that it may be easy to carry out screw processing etc. and it may become, it is screwed by header processing and forming of rolling, and is processed into a configuration. Subsequently, hardening and artificial-aging hardening processing are performed, reinforcement is raised, and screw is completed. By processing it at such a process, the average die length of the crystal grain of the longitudinal direction of screw is pressed down by 200 micrometers or less. Moreover, it is tensile strength 350Ns/mm 2 It is proof stress 300Ns/mm above 2 They are 6% or more and torsional strength about elongation above JIS-B -1057-1989 It can be made the value of AL3 (A6061-T6) high 10% or more. The reason for pressing down the average die length of the crystal grain of the longitudinal direction of screw to 200 micrometers or less by this invention is because toughness will fall if it exceeds 200 micrometers, and it is divided at the time of bolting of screw. Especially the average die length of said crystal grain has desirable 100 micrometers or less.

[0024]

[Example] (Example 1) The aluminium alloy of this invention presentation shown in No.1-27 of Table 2 was cast in the semi-continuous casting method to the billet of 219mmphi, the obtained ingot was cut in die length of 300mm, and this was homogenized at 540 degrees C for 4 hours, and subsequently hot extrusion was carried out at 470 degrees C, it considered as the wire rod of 9mmphi, and this wire rod was processed into the strand of 3.46mmphi by the production process A shown in Table 4. Subsequently, a cutting machine 2 cuts this strand 1 to predetermined die length (drawing 1 I), a head 4 is formed for this with the header processing machine 3 (drawing 1 RO), a thread part 6 is formed with the thread rolling processing machine 5, and it is ** (drawing 1 Ha, NI). Next, after carrying out after [1 hour heating] water quenching at 540 degrees C, artificial-aging hardening processing was performed at 180 degrees C for 8

hours, and screw of M4 was manufactured. The dimension of the M4 screw 7 is shown in drawing 2 . In addition, at the time of said cephalogenesis, the crack occurred in the root and the sulcus-cruciatus section of a head, and the crack generated what has bad workability at the thread part at the time of said forming of rolling.

[0025] (Example 1 of a comparison) Table 3 Aluminium alloys other than this invention presentation shown in No.28-49 are cast in a semi-continuous casting method to the billet of 219mmphi. Cut the obtained ingot in die length of 300mm, and this is homogenized at 540 degrees C for 4 hours. Subsequently, hot extrusion was carried out at 470 degrees C, and it considered as the wire rod of 9mmphi, and considered as the strand of 3.46mmphi by the production process B which shows this wire rod in Table 4, this strand was processed like the example 1, and screw of M4 was manufactured.

[0026] (Conventional example 1) Table 3 The alloy (A6061, A5052, A5056, A2024, A7N01) was cast in the semi-continuous casting method to the billet of 219mmphi conventionally which is shown in No.50-54, the obtained ingot was processed like the example 1 of a comparison, and screw of M4 was manufactured.

[0027] About each acquired screw, screw workability (header workability, thread rolling nature) was investigated. Moreover, a tension test, a torsion test, microstructure observation of the cross section of a longitudinal direction, and a corrosion test were performed. A result is shown in Tables 4-7. The criterion of a trial, the observation approach or good, and a defect is shown below.

(1) Header workability : that whose header processing was completed satisfactory -- Good (O).

Thing broken during header processing ..... Defect (x).

(2) Forming-of-rolling nature : that whose screw-thread processing of M4 was completed satisfactory .... Good (O).

Thing broken during the thread rolling of M4 ..... Defect (x).

(3) Tractive characteristics : as shown in drawing 3 , on both sides of the M4 screw 7, the tension test was carried out by the upper chuck 8 and the bottom chuck 9.

Tensile strength is 2 350Ns/mm. The above thing ..... Good (O).

Tensile strength is 2 350Ns/mm. Thing of the following .... Defect (x).

Proof stress is 2 300Ns/mm. The above thing ..... Good (O).

Proof stress is 2 300Ns/mm. Thing of the following ..... Defect (x).

Elongation is 6% or more of thing..... Good (O).

Elongation is less than 6% of thing..... Defect (x).

(4) After having turned the handle 11 for the M4 screw 7 to the fixture 10 in torsion strength as shown in : drawing 4 , and fixing firmly, it turned until it fractured the M4 screw 7 with Phillips screwdriver 13 attached in the torque meter 12, and the torque value at the time of fracture (torsional strength) was calculated. The reference value of torsional strength was made into 1.54 N-m higher 10% or more than value-of-standard 1.4 N-m of AL3.

Torsional strength is the thing of 1.54 or more N-m..... Good (O).

Torsional strength is the thing of less than 1.54 N-m.... Defect (x).

(5) Measurement of crystal grain die length : as shown in drawing 5 (b) and (b), after cutting the M4 screw 7 perpendicularly and grinding the cross section, it etched, the part of 14 was observed with the metaloscope, and the die length 15 of the longitudinal direction of each crystal grain was measured about 50 crystal grain.

The average is a thing 200 micrometers or less..... Good (O).

That to which the average exceeded 200 micrometers ..... Defect (x).

(6) The corrosion test approach : as shown in drawing 6 , A6063 alloy plate (3x100x100mm) 17 was bound tight with the nut 16 of the same quality of the material as the M4 screw 7, it considered as the specimen, and this was immersed into the 5% brine 19 in the tub 18 made from stainless steel. Said specimen has been arranged on the insulating bakelite base 20. The drawing corrosion situation was investigated for the specimen after 1000-hour progress.

What has corrosion resistance equivalent to the bolt made from A6061 ..... Good (O). That in which corrosion resistance is inferior to the bolt made from A6061 ..... Defect (x).

[0028]

[Table 2]

[0029]

[Table 3]

[0030]

[Table 4]

[0031]

[Table 5]

[0032]

[Table 6]

[0033]

[Table 7]

[0034]

[Table 8]

[0035]
[Table 9]
[0036]
[Table 10]
[0037]
[Table 11]
[0038] No.1-54 (Tables 5-8) of the example of this invention shows [in / each / so that more clearly than Tables 5-11 / workability, the tension test of screw, a torsion test, a microstructure, and a corrosion test] a good property, and is the conventional example synthetically. No.77-86 (Table 11) It was what excellent. Moreover, about the production process (Table 4), the A showed the good property from B about the tension test of screw, the torsion test, and the microstructure. On the other hand, example of a comparison Since an alloy presentation was outside this invention presentation, one of properties became poor and No.55-76 (Tables 9 and 10) became a thing inferior to comprehensive evaluation.
[0039] (Example 2) The aluminium alloy of this invention presentation shown in No.1-27 of Table 2 was cast in the semi-continuous casting method to the billet of 219mmphi, the obtained ingot was cut in die length of 300mm, and this was homogenized at 540 degrees C for 4 hours, and subsequently hot extrusion was carried out at 470 degrees C, it considered as the wire rod of 10mmphi, and this wire rod was processed into the strand of 7.1mmphi by the production process C shown in Table 9. Next, after the cutting machine 2 cut this strand 21 to predetermined die length (drawing 7 I), and having carried out header processing of this in two steps of a spherical-head -> hexagon head, having formed the head 24 (drawing 7 RO, Ha), forming the thread part 26 with the thread rolling processing machine (drawing 7 NI) and carrying out after [1 hour heating] water quenching at 540 degrees C subsequently, artificial-aging hardening processing was performed at 180 degrees C for 8 hours, and M8 volt 27 was manufactured. The dimension of M8 volt 27 is shown in drawing 8 . In addition, at the time of cephalogenesis, the crack occurred in the root and the sulcus-cruciatus section of a head, and the crack generated what has bad workability at the thread part at the time of forming of rolling.
[0040] (Example 2 of a comparison) Table 3 Aluminium alloys other than this invention presentation shown in No.28-49 are cast in a semi-continuous casting method to the billet of 219mmphi. Cut the obtained ingot in die length of 300mm, and this is homogenized at 540 degrees C for 4 hours. Subsequently, hot extrusion was carried out at 470 degrees C, and it considered as the wire rod of 10mmphi, and considered as

the strand of 7.1mmphi by the production process D which shows this wire rod in Table 9, this strand was processed like the example 2, and the bolt of M8 was manufactured.

[0041] (Conventional example 2) Table 3 The alloy (A6061, A5052, A5056, A2024, A7N01) was cast in the semi-continuous casting method to the billet of 219mmphi conventionally which is shown in No.50-54, the obtained ingot was processed like the example 2 of a comparison, and the bolt of M8 was manufactured.

[0042] About each acquired screw, screw workability (header workability, thread rolling nature) was investigated. Moreover, the tension test of screw, microstructure observation of the cross section of a longitudinal direction, and a corrosion test were performed by the same approach as an example 1. A result is shown in Tables 10-15.

[0043]

[Table 12]

[0044]

[Table 13]

[0045]

[Table 14]

[0046]

[Table 15]

[0047]

[Table 16]

[0048]

[Table 17]

[0049]

[Table 18]

[0050] It is an example of this invention so that more clearly than Tables 12-18. No.87-140 (Tables 12-15) Each shows a good property in workability, the tension test of screw, a microstructure, and a corrosion test, and it is No.163-167 (Table 18) of the conventional example synthetically. It was what excellent. Moreover, about the production process (Table 9), C showed the good property from D about the tension test of screw, the torsion test, and the microstructure. On the other hand, No.141-162 of the example of a comparison (Tables 16-17) Since an alloy presentation was outside this invention presentation, one of properties became poor and it became a thing inferior to comprehensive evaluation.

[0051] As mentioned above, although screw made from an aluminium alloy (a bolt is included) was explained, even if it applies this invention to nuts, the same effectiveness is acquired, and larger effectiveness is acquired by

using combining the screw thread (a bolt being included) of this invention.

[0052]

[Effect of the Invention] As stated above, screw made from a high intensity aluminium alloy of this invention (a bolt is included) Tensile strength is 2 350Ns/mm. Proof stress is 2 300Ns/mm above. Above, Elongation is 6% or more and torsional strength is JIS-B -1057-1989. The average crystal grain die length of 10% or more of AL3 (A6061-T6) and a longitudinal approach is a thing 200 micrometers or less. It has tractive characteristics sufficient as the screw thread and a bolt for joining the structure made from an aluminium alloy, torsional strength, and stress-corrosion-cracking-proof nature, and the stable high joint reinforcement is obtained. Moreover, it excels also in header workability and thread rolling workability, and processing is easy. Moreover, since the screw thread of this invention is a 6000 system alloy, when it uses for junction of the structures made from a 6000 system alloy, such as a sash and an automobile, there are few falls of purity at remelting of a scrap, and it excels in recycle nature, for example. Furthermore, the screw thread of this invention can be easily manufactured by the usual manufacture approach of having specified a part of manufacture conditions. Therefore, remarkable effectiveness is done so on industry.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (b) - (d) are the fabrication explanatory views of M4 screw.

[Drawing 2] It is the dimension explanatory view of the screw thread of M4.

[Drawing 3] It is the mimetic diagram of the tension test of a screw thread.

[Drawing 4] It is the perspective view of a torsion tester.

[Drawing 5] (b) is a test piece for the crystal grain measurements of length, and (b) is the explanatory view of the measuring method of crystal grain die length.

[Drawing 6] It is the explanatory view of the corrosion test approach.

[Drawing 7] (b) - (d) are M8 volt fabrication explanatory views.

[Drawing 8] It is an M8 volt dimension explanatory view.

[Description of Notations]

1 Strand for M4 screw

2 Cutting Machine

3 Header Processing Machine

4 Head of M4 screw

5 Thread Rolling Processing Machine

6 Thread Part of M4 screw
7 M4 screw
8 Upper Chuck
9 Bottom Chuck
10 Fixture
11 Handle
12 Torque Meter
13 Phillips Screwdriver
14 Crystal Grain Measurements-of-Length Part of M4 screw
15 The Die Length of Crystal Grain
16 Nut
17 A6063 Alloy Plate
18 Tub made from Stainless Steel
19 Brine
20 Bakelite Base
21 Strand for M 8 Volts
24 M8 Volt Head
26 M8 Volt Thread Part
27 M8 Volt